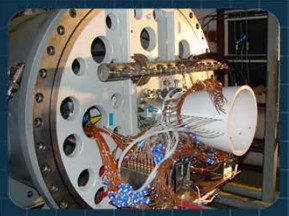
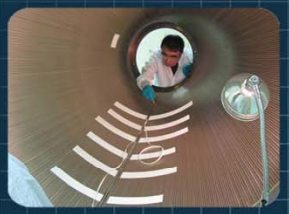
NRPS

NATIONAL INSTITUTE FOR ROCKET PROPULSION SYSTEMS




Rocket and Missile Propulsion: Shared Challenges, Shared Solutions

Society of Cost Estimating and Analysis (SCEA)

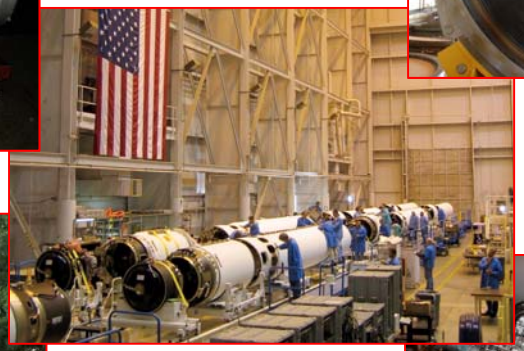
Greater Alabama Chapter

April Luncheon

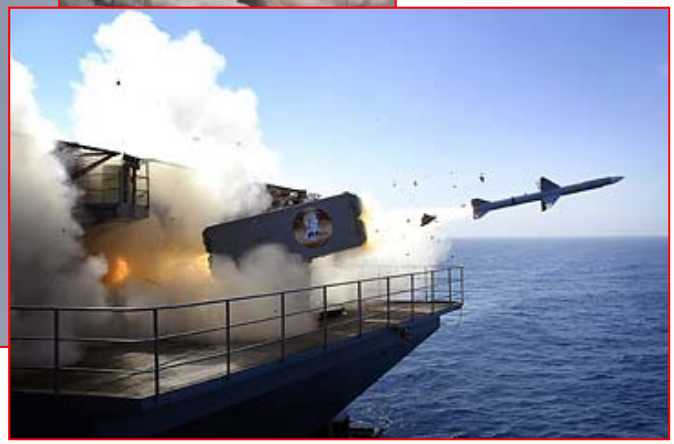
Tuesday, April 17, 2012

William P. Ondocsin, P.E.
National Institute for Rocket Propulsion Systems
NASA Marshall Space Flight Center

It Really is Rocket Science



Rockets and Missiles: Critical to our Country



Propulsion in the headlines

THE WALL STREET JOURNAL.

DOWJONES

FRIDAY, MARCH 16, 2012 - VOL. CCLIX NO. 62 WSJ.com ★★ $2.00

DJIA 13252.76 ▲ 58.66 0.4% NASDAQ 3056.37 ▲ 0.5% NIKKEI 10123.28 ▲ 0.7% STOXX 600 270.98 ▲ 0.3% 10-YR. TREAS. ▼ 1/32, yield 2.278% OIL $105.11 ▼ $0.32 GOLD $1,659.10 ▲ $16.60 EURO $1.3080 YEN 83.57

United Tech Plans to Sell Industrial, Wind Units

By Kate Linebaugh

Seeking to maintain its credit rating while not angering shareholders, **United Technologies** Corp. changed its financing plans for the $16.5 billion acquisition of aircraft-components maker **Goodrich** Corp., announcing the sale of several units including its Rocketdyne rocket-engine business.

United Technologies expects to raise about $3 billion by year-end through the sale of the businesses, which also include its Clipper Windpower wind-energy business and its Hamilton Sundstrand Industrial businesses.

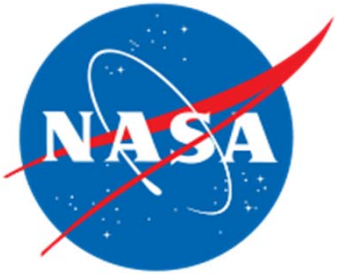
"Back in September when we initially laid out the financing plans it was pretty simple, we were going to borrow about $12.5 billion and issue about $4 billion in equity, and nobody liked it," Chief Financial Officer

Jim Maser, president of Pratt & Whitney Rocketdyne, said United Technologies' announcement was not a surprise. "We've been prepared for today's news," he said. "I've been involved in the process. I don't see the sale making a major impact on our business strategy. I'm optimistic about our future." – Los Angeles Times

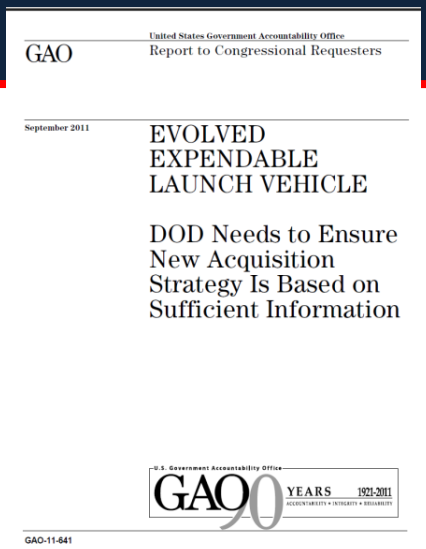
Drexel Hamilton analyst Rick Whittington gave a mixed review to the sales. He said "good riddance" to Rocketdyne, which represents the "end of an era" in space travel. - Associated Press

"Without a national space policy, growth will be limited," Chief Financial Officer Greg Hayes told analysts. – Associated Press

US Government Propulsion Stakeholders



State of the Rocket Propulsion Base


United States Government Accountability Office
Report to Congressional Requesters

GAO

September 2011

EVOLVED EXPENDABLE LAUNCH VEHICLE

DOD Needs to Ensure New Acquisition Strategy Is Based on Sufficient Information

U.S. Government Accountability Office
GAO 90 YEARS 1921-2011
ACCOUNTABILITY • INTEGRITY • RELIABILITY

GAO-11-641

- **More than 40 industrial base studies** and assessments, focused on the challenges facing the propulsion community, have been performed over the past decade.

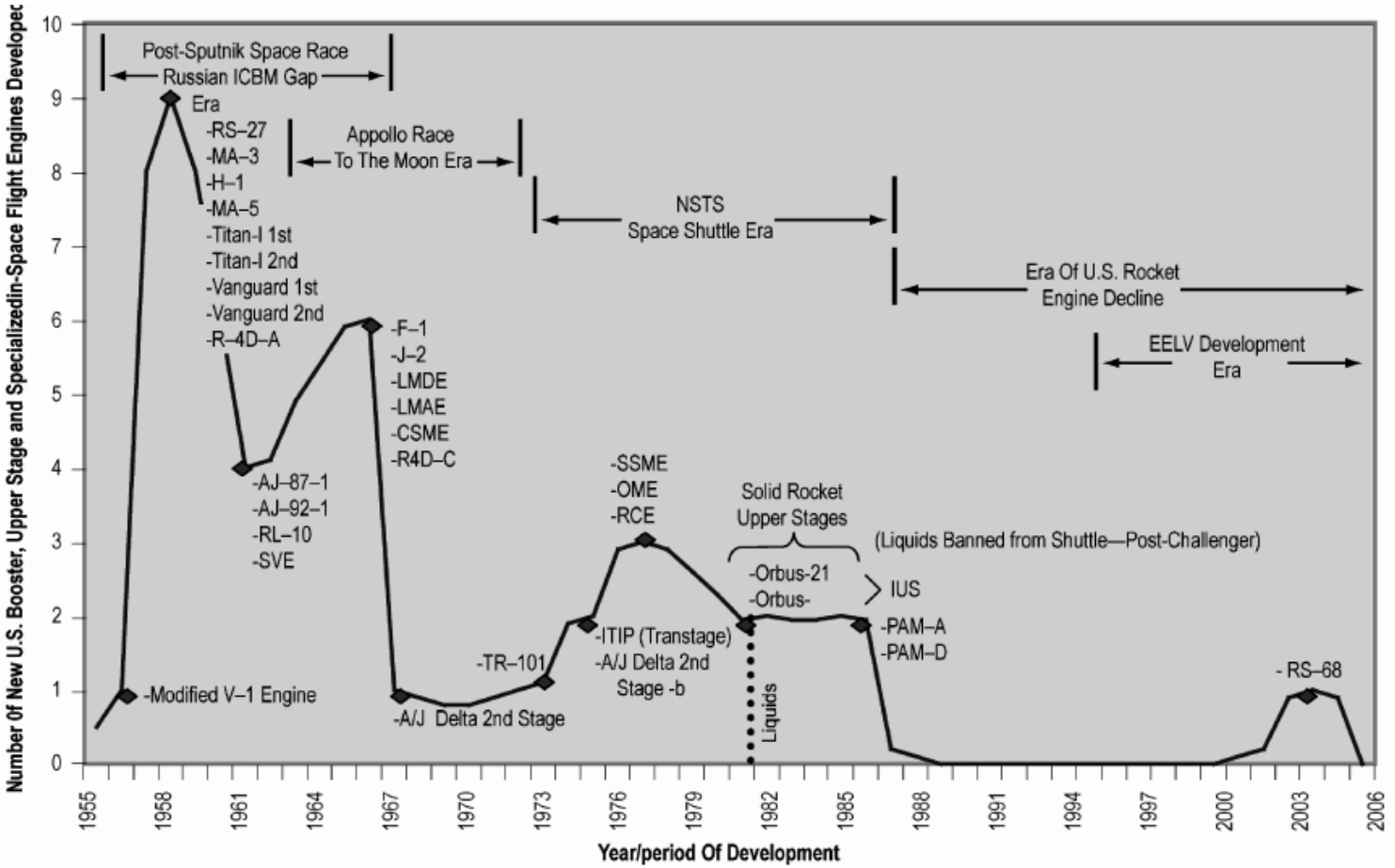
- **Common problematic themes:**
  - Budget constraints require acquisition programs to rely on heritage hardware, leading to a lack of development programs to sustain workforce and suppliers
  - Absence of an integrated science and technology plan for launch technologies
  - Difficulty in obtaining access to government facilities

- **2011 GAO report** highlights the need for better information and government-wide coordination to support DOD EELV acquisition strategy decisions

- **2012 NRC report** on NASA Space Technology Roadmaps and Priorities names "Improved Access to Space" a top technical challenge to all 3 2011 NASA Strategic Plan goals

The Challenges are Known

U.S. Rocket Engine Development History



Ref: Sackheim, AIAA-23257-7531, Journal of Propulsion and Power, Nov. – Dec. 2006

No Competitive Liquid Rocket Engine Developments in 3 Decades

U.S. Propulsion Program Stability

Aerojet Launch Vehicle Propulsion Programs Over the Last 20 Years

Engine Program	Application	Customer	Program Maturity
			Preliminary Design / Component Development / Demonstration Testing / Protoqual / Qualification / Full Scale Development / Flight / Production
Transtar	Upper Stage	A/F	
Uprated OME	Shuttle	NASA	
XLR-132	High Performance Upper Stage	A/F	
XLR-134	Cryogenic Upper Stage	A/F	
NLS	Low Cost Booster Engine	NASA	
ALS	Low Cost Booster Engine	NASA	
LOCUS	Low Cost Upper Stage	A/F	
Agena-2000	Low Cost Upper Stage	A/F	
X-33 RCS	Low Cost RCS Engines	NASA	
Green RCS	LOX/Ethanol RCS	NASA	
Cobra	RLV Booster Engine	NASA	
ARRE	Advanced Peroxide Upper Stage	A/F	
HOPE-X	Japanese Upper Stage	Japan	
Atlas V Solid	Advanced Solid Rocket Booster	L/M	

Commercially Funded

We Need A Plan and Commitment to "Stick to It" and Finish What We Start

Ref: Van Kleeck, Von Braun Symposium, Oct. 26, 2011

A Shared Stake in the Industrial Base

- **"Maintaining our industrial base and a viable highly skilled workforce is essential to DOD."**
  Brig. *Gen. Ole Knudson, PEO Missiles & Space, Army Aviation & Missile Command, Hail to AMC, (12/12/11)*
- "**Anything that NASA does is important to us in terms of the industrial base.** And anything that we do is important to NASA as well."
  Gregory Schulte, Deputy Assistant Secretary of Defense for Space Policy, The National Journal (7/20/11)
- "As constrained DoD budgets become more strained by higher priority programs, **investments in missile research & development and procurement may be more challenged."** *Annual Industrial Capabilities Report To Congress, May 2010, DoD report*
- "The need to move with clear velocity is imperative if we are **to sustain our endangered U.S. space industrial base**, to protect our national security, and to retain our positions as the world leader in humans spaceflight and space exploration."
  Jim Maser, Chairman of Corporate Membership Committee AIAA and President, Pratt & Whitney Rocketdyne. Testimony to Congress (3/30/11)

A Shared Industrial Base Underlies Both DoD & NASA Propulsion Systems

Collaboration: A National Pursuit

- "**Departments and agencies shall improve their partnerships through cooperation, collaboration, information sharing, and/or alignment of common pursuits.** Departments and agencies shall make their capabilities and expertise available to each other to strengthen our ability to achieve national goals, identify desired outcomes, leverage U.S. capabilities, and develop implementation and response strategies."
  National Space Policy June 28, 2010

- "We seek to foster a U.S. space industrial base that is robust, competitive, flexible, healthy, and delivers reliable space capabilities on time and on budget. DoD and the IC [Intelligence Community], in concert with the civil space sector, **will better manage investments across portfolios to ensure the industrial base can sustain those critical technologies and skills that produce the systems we require.**"
  National Security Space Strategy (Unclassified Summary) January 2011

National policy guidance directs military and civilian agencies to collaborate

Recognizing Sustainment/Industrial Base Issues

SLS: Impacts on the Propulsion Base

- **Boosters**
  - 5-segment Solid Rocket Booster in-scope modification to existing Ares contract with ATK for initial flights through 2021
  - Advanced Boosters
    - Engineering demonstration and risk reduction via NASA Research Announcement (NRA): Full and Open Competition (FOC) in FY12, with award by FY13 (Industry Day on Dec 15, 2011)
    - DDT&E: FOC, with Request for Proposals (RFP) target in FY15
- **Stages**
  - Core/Upper Stage: Justification for Other Than Full and Open Competition (JOFOC) to Boeing, modifying current Ares Upper Stage contract
  - Avionics (Instrument Unit): In-scope modification to existing Ares contract with Boeing; consolidated with Stages contract to Boeing
- **Engines**
  - Core Stage Engine: RS-25 JOFOC to existing Space Shuttle contract with Pratt & Whitney Rocketdyne (PWR)
  - Upper Stage Engine: J-2X in-scope modification to existing Ares contract with PWR
- **Spacecraft and Payload Adapter and Fairing**
  - Initial design: Payload Adapter and Fairing design/development in-house through Preliminary Design Review (PDR)
  - FOC to begin in FY13
- **Advanced Development**
  - Broad Agency Announcement (BAA)/NASA Research Announcement (NRA): FOC in FY12
  - Future Core Stage Engine: Separate contract activity in FY12

INITIAL

EVOLVED

An Easy Solution?

NIRPS: Capability Sustainment Beyond the Gate

Scope:

National
Multi-organizational
Multi-sector

Purpose:

NIRPS will help preserve and align government and private rocket propulsion capabilities to meet present and future US commercial, civil, and defense needs, while providing insight and recommendations to National decisional authorities

Tri-faceted approach:

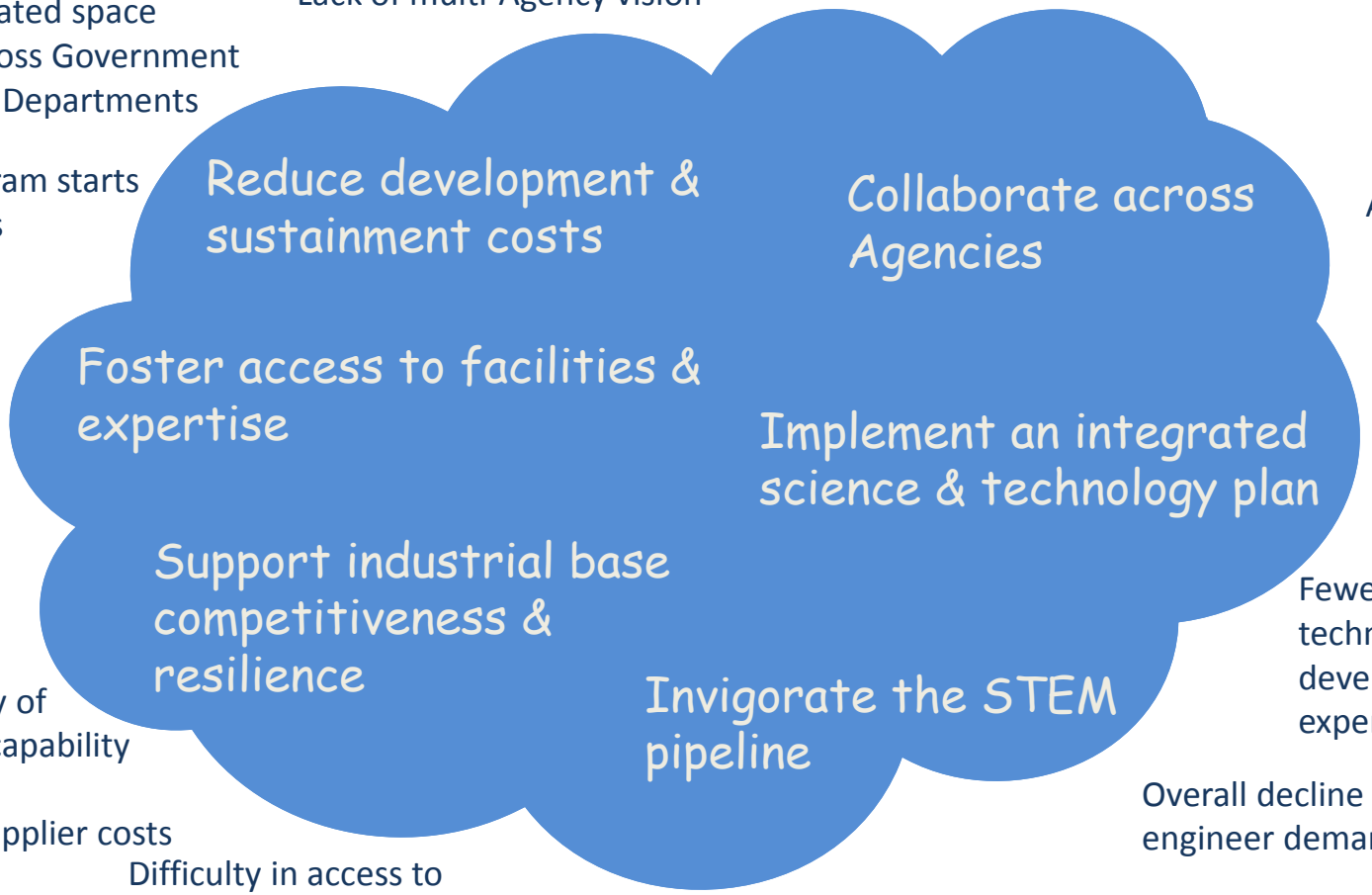
- **Stewardship:** Formulate and recommend National Policy options and strategies that promote a healthy industrial base
- **Technology:** Identify technology needs and recommend technology insertions
- **Solutions facilitator:** Maintain relationships and awareness across the Government and industry to align available capacity with emerging demand

A Jointly Created and Sponsored Institute Providing Coherent Policy Recommendations to National Decision Authorities

Planning Team

All Sectors of the Propulsion Community are Engaged in NIRPS Formulation Efforts

Grand Challenges



Lack of integrated space strategies across Government Agencies and Departments

Lack of multi-Agency vision

Lack of defined space missions

Lack of predictable long-term funding

Frequent program starts & cancellations

Aging work force

Shuttle retirement

Lack of sustained technology development

Uncertainty in future needs

Industrial base decline

Fewer engineers have technology development experience

Overcapacity of production capability

Overall decline in aerospace engineer demand

Rising supplier costs

Difficulty in access to government facilities

Large solid rocket motor industrial base decline

Systems infrastructure, supply chain, & skill base challenges

Loss of competitiveness in the global market

Attacking the Issues

Grand Challenge	Stewardship Dr. Jamie Neidert AMRDEC	Technology Dr. George Schmidt NASA-GRC	Solutions Facilitator Dr. Tom Brown NASA-MSFC
Support the competitiveness and resilience of the industrial base	Primary	Secondary	Secondary
Invigorate the STEM pipeline	Primary	Secondary	Secondary
Develop and implement an integrated science & technology plan for propulsion systems.	Secondary	Primary	Secondary
Reduce development and sustainment costs for missile and rocket systems	Secondary	Primary	Secondary
Collaborate across agencies for missile and rocket propulsion system development	Secondary	Secondary	Primary
Foster access to facilities and expertise across Government, industry, and academia	Secondary	Secondary	Primary

NIRPS will address open needs and coordinate across the domains

Forum Assessment

National Needs / Forums	Forum for Collaboration (Technical Exchange/ Teaming/ Partnership)	STEM	Technology Roadmap Assessments	Recurring Industrial Base Assessments (Corporations, Faciliites, Infrastructure, Obsolence)	Access to Engineering Resources to Address Problems	Coordination and Synchronization of Government Investments	Scenario Analysis (in Support of Acquisition Strategy)	Policy Analysis and Recommendation
Associations/Councils								
JANNAF	Primary	Contributing	Contributing	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed
AIAA	Primary	Contributing	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Contributing
AIA	Contributing	Not Addressed	Not Addressed	Contributing	Not Addressed	Not Addressed	Not Addressed	Primary
NDIA	Contributing	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Contributing
SIBC	Not Addressed	Not Addressed	Not Addressed	Primary	Not Addressed	Not Addressed	Not Addressed	Primary
Sponsored Programs								
RP21 (IHPRPT)	Contributing	Contributing	Primary	Not Addressed	Not Addressed	Primary	Not Addressed	Not Addressed
NRPTA	Primary	Not Addressed	Not Addressed	Not Addressed	Primary	Primary	Not Addressed	Not Addressed
XUIP (CUIP)	Not Addressed	Primary	Not Addressed	Not Addressed	Contributing	Not Addressed	Not Addressed	Not Addressed

Needs Assessment

	Forum for Collaboration (Technical Exchange/ Teaming/ Partnership)	STEM	Technology Roadmap Assessments	Recurring Industrial Base Assessments (Corporations, Faciliites, Infrastructure,	Access to Engineering Resources to Address Problems	Coordination and Synchronization of Government Investments	Scenario Analysis (in Support of Acquisition Strategy)	Policy Analysis and Recommendation
Aggregate Assessment	**Well Addressed**	**Slightly Addressed**	**Moderately Addressed**	**Slightly Addressed**	**Slightly Addressed**	**Slightly Addressed**	Not Addressed	**Moderately Addressed**

Accomplishments Since September 2011

NIRPS Establishment

- Developed "Propulsion Forum & Needs Assmt" matrix to distinguish NIRPS role relative to other forums
- Established NIRPS Strategy Teams with broad membership
- Established NIRPS Planning Team bi-weekly with broad participation
- Established initial NIRPS Web Site
- Developed preliminary concepts for interim governance model

Partnership Collaboration

- NIRPS Government Meeting Kickoff (Oct)
- Briefed the NIRPS concept with multiple senior officials and general officers within DoD
- Supported AFRL with Fleet Viability Assessment for MMIII (cancelled)
- Supported negotiations with USAF on AUSEP collaboration
- Visits to AF, SMDC, MDA, OSD, etc.

Propulsion Studies

- Completed assessment for 23 public studies
- Conducting review of 21 restricted access studies
- Completed prelim assessment of SBU industrial base studies
- Drafting paper on historical studies of industrial base
- Supporting Dept. of Commerce Industrial Base Survey
- Supported DoD on Liquid Rocket Engine Industry-base Assessment

Goals & Strategy

- Identified key concerns of the propulsion community
- Developed Grand Challenges & allocated Primary/Secondary responsibilities to NIRPS Strategy Teams
- Developed draft Strategies to meet Grand Challenges
- Begun further development of Strategies into Objectives – prioritization & metrics in work

Planning Activities

- Started preparations for support of Defense Authorization 1095
- Stewardship team developing FOMs to assess the health of the Prop Industry Base
- Technology team assessing Agency's Propulsion Technology Roadmaps in relation to other Agency needs
- Solutions Facilitator team developing strategy for easier access to USG facilities & expertise
- Initiated work on Propulsion EcoSystem

Forums Supported

- Von Braun Symposium (Oct) – outlined 'Grand Challenges'
- Space Trans. Policy Workshop at GWU (Nov)
- JANNAF Plenary Session (Dec) – outlined 'Plan of Attack'
- National Defense Industrial Association (NDIA) (Feb)
- Space Trans. Assoc. Breakfast (Oct)

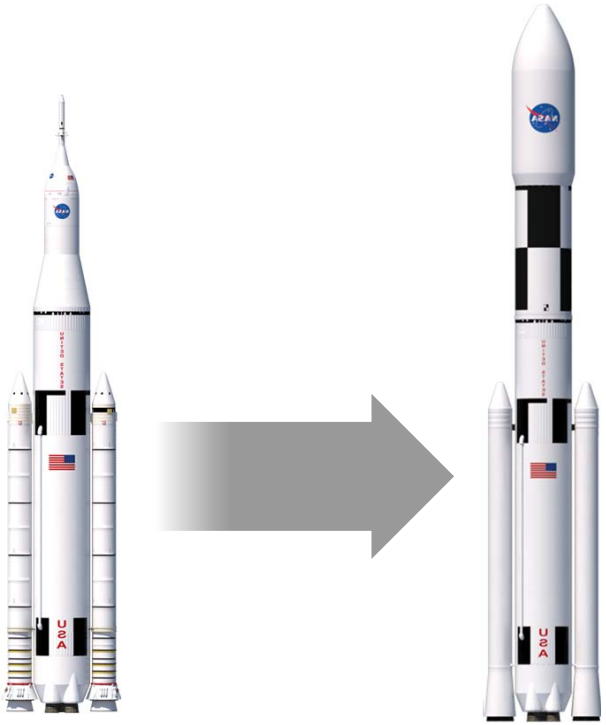
Many uses – One commodity

Additional NIRPS Value-Added Insight

National Defense Authorization Act for Fiscal 2012
National Rocket Propulsion Strategy

SLS Advanced Booster Procurement

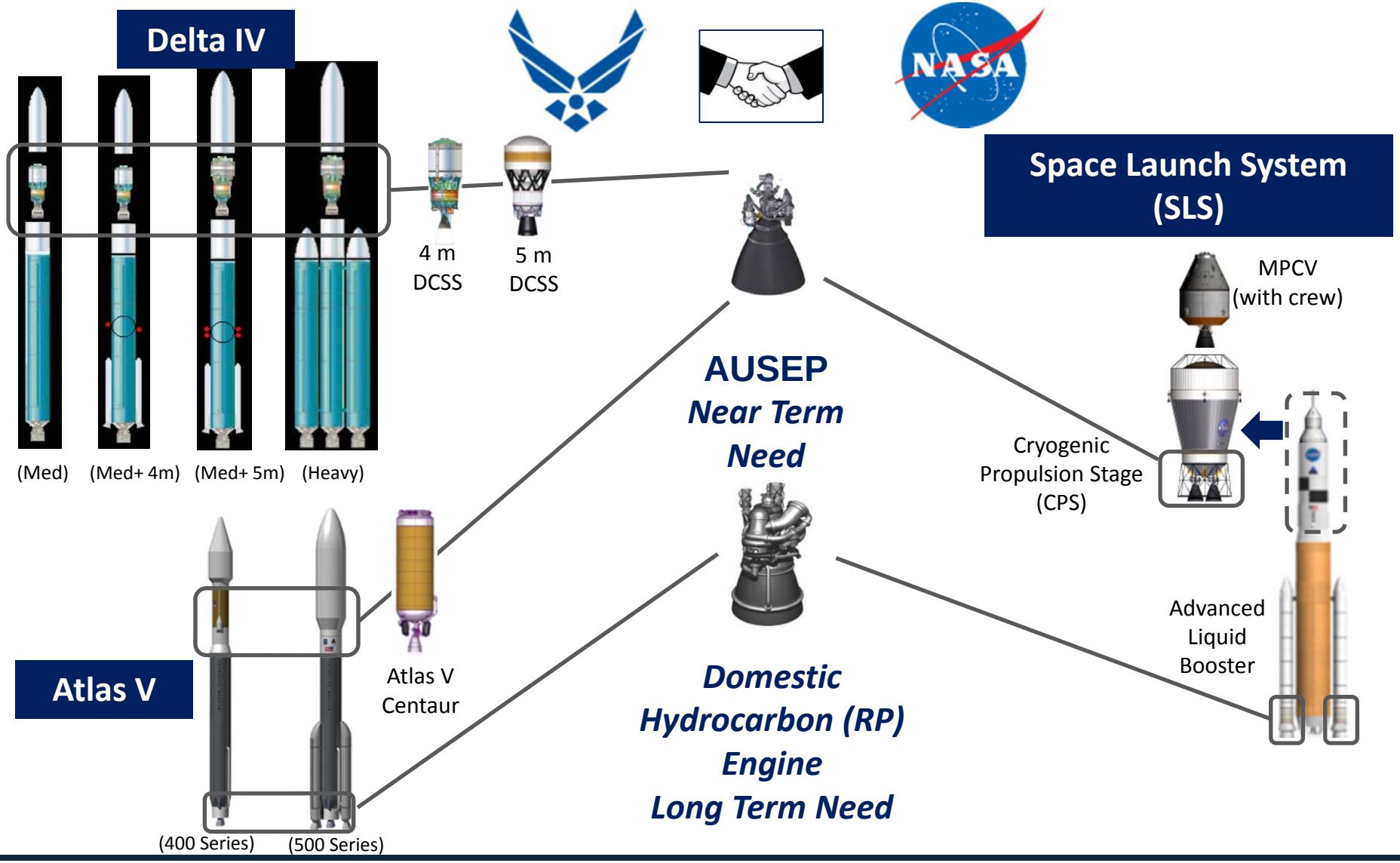
SLS Advanced Development NRA to NIRPS Grand Challenges



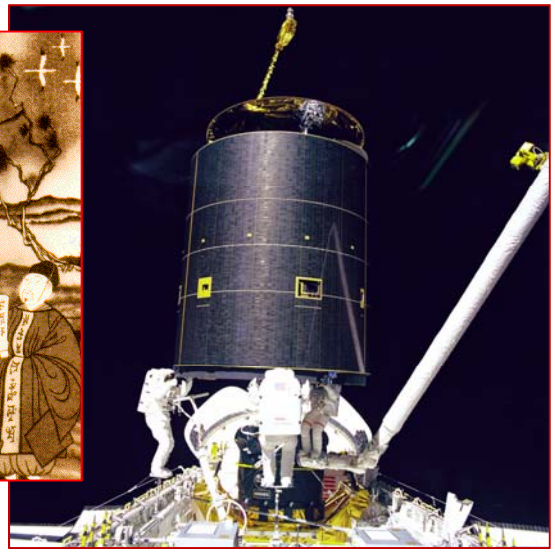
INITIAL CAPABILITY, 2017–21

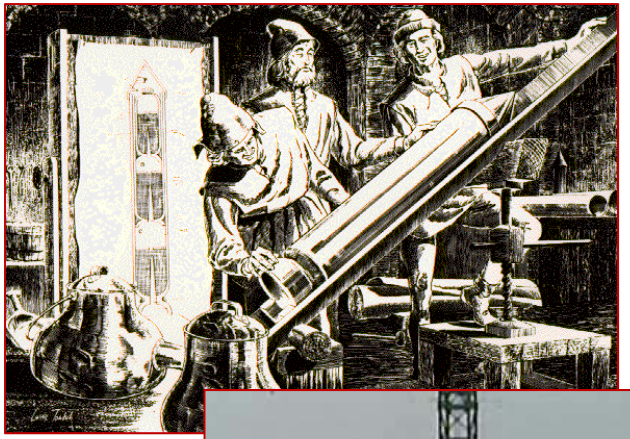
EVOLVED CAPABILITY, Post-2021

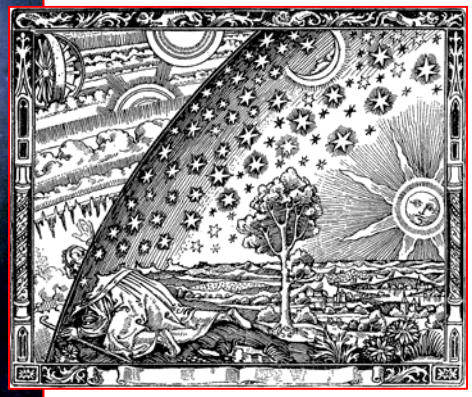
Near-term Partnership Opportunities



Rocketry and Reality



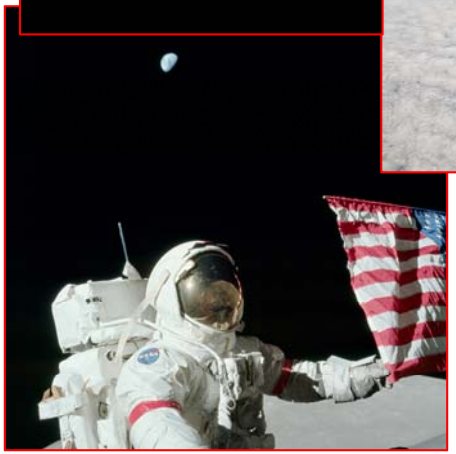


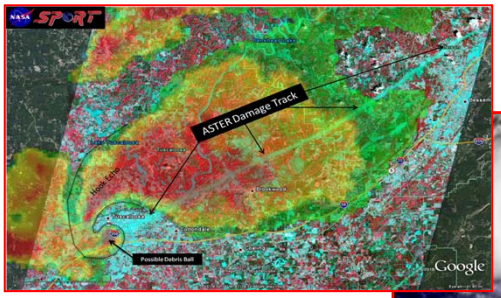


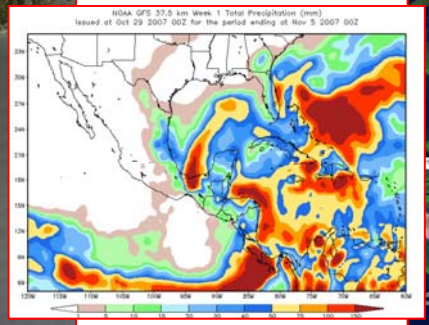
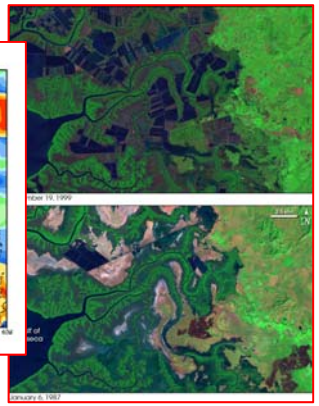
Rockets: closer to our lives than we realize



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